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AN EXPERIMENTAL forest is an outdoor laboratory where investigations of plant life may be studied under natural conditions. To be most useful it should be typical of the forested area that it represents so that the results obtained may have general application.

The Kawishiwi Experimental Forest, located thirteen miles southeast of Ely, Minn., within the Superior National Forest, is an example of such a laboratory. This 2,800-acre tract of timber was set aside in 1931 from the national forest for use by the Lake States Forest Experiment Station in making silvical investigations and studies of various forest problems.

To visualize and appreciate this forest one should have an understanding of (1) the soils and topography in this region, (2) the timber types present and the trends in forest succession

This "4000 B. C. plow" was found to be an effective implement for tearing up the duff among the stumps and rocks.

in this climate, and (3) the factors interfering with natural tendencies.

The last glacial invasion left, over most of this area, only a thin mantle of soil. Although the soil is a fertile loam, it averages not more than 2 feet in depth and is underlaid by a hard granite-like rock that outcrops in many places . The topography consists of long and narrow rock ledges, and the drainage between them is often poor, resulting in the occurrence of peat swamps. The ledges are usually less than 25 feet high, yet, due to their steep sides, the topography is rough. However, considering the area as a whole, there are no great changes in elevation.

THE timber types may be divided into two general classes, swamp and upland. The swamps occupy 28 per cent of the total area of the experimental forest, and slightly over half of the swamp area has been classified as productive. The deeper swamps support only stunted black spruce and tamarack, but the shallower ones produce fine stands of black spruce. The larch sawfly killed most of the tamarack about 1915, and as a result black spruce is the only species of importance in this type. Periodically also the spruce budworm has been a menace to spruce, but its greatest injury has been to balsam. The ages of the spruce stands in the productive swamps range from 40 to 150 years, and the stands are dense, supporting 500 to 750 trees over 4 inches d.b.h. per acre.

Jack pine is the predominant upland species, but it is often found growing in a mixture with aspen, paper birch and black spruce. In a pure stand of 65 to 70-year-old jack pine (the main age-class on the forest) the number of stems over four inches d.b.h. is about 450 per acre. Black spruce trees are as numerous as aspen, but they are smaller in size and contribute less to the timber volume. Scattered balsam fir, white pine, Norway pine and white spruce may also be found.

THESE mixed types are not, in general, stable associations. The cold climate, heavy brush understory, loam soil and abundant rodent life is unfavorable to the reproduction of most of these species. Without disturbances such as fire, insect attacks, or logging, the intolerant species would eventually disappear. Jack pine and aspen, especially, are poorly adapted to maintaining themselves under the circumstances mentioned. The shade-tolerant balsam fir and spruce are the chief species that are

Stand of 65-year-old jack pine in which a growth study is being made.

reproducing under the present stands, and it is believed that they will finally, if allowed to run their natural course without disturbance, form a climax forest.

OFTEN the natural trend of the forest succession is changed by such factors as fire, wind, and insect attacks. During the period 1855-1890 severe fires swept through this region. Because some of the swamps survived the conflagration, the typical swamp species, black spruce and tamarack, were given the opportunity of assisting jack pine, aspen and paper birch in starting a new forest. The few white pine, Norway pine, white spruce, and balsam fir that survived the fires helped in a lesser extent in establishing the present forest.

THE causes of the conflagrations of the last century are not known. There may have been a period of very dry years, or perhaps, due to forest catastrophes such as wind-storms or insect attacks, large volumes of fuel accumulated. A clue to how such conditions may have originated was supplied by a wind-storm which struck the experimental forest in 1932. This storm, which was comparable in intensity with those of the mid-west prairie region, did a tremendous amount of damage. The damage by uprooting and breaking amounted to 17 percent of the total number of trees, and since the losses were mainly in the upper crown classes, the loss in volume was even greater. The windfalls were not distributed uniformly throughout the stand, but were concentrated in patches, with the result that a serious fire hazard was created.

The stand of timber on the experimental forest is mostly suitable for use as pulpwood and mine timbers. Spruce is the most valuable pulpwood species, and jack pine can be used for both purposes. The market for aspen and birch of the quality present is poor. The volume of merchantable timber is shown in the following table:

	Volume	
Species	Cords	M. Ft. BM
Aspen and birch	3782	1639
Jack pine	2027	3810
Spruce	4421	.....
Others	296	146
Total	10,526	5,595

THE common species, jack pine, aspen and spruce, do not attain large size. The range in sizes of the trees in a typical 70-year-old jack pine stand is from 4 to 14 inches d.b.h., and the average size is about 8 inches. It may be surprising to persons accustomed to think of timber in terms of Douglas fir and Ponderosa pine to know that the yields are good. This is because of the short rotations and dense stands.

In the five years since the experimental forst was established the major physical improvements have been completed. They consist of a headquarters development and a road and trail system. The most important improvement work which has been done in the forest is the construction of a road system which makes the tract accessible for fire protection, utilization and demonstration. The fire hazard created by the 1932 wind-storm has necessitated extensive clean-up work. The federal relief programs, especially the CCC, have accelerated the completion of these improvements.

Major emphasis in the investigative work has been placed on the development of cutting methods for spruce and jack pine stands because most of the timber in this tract may be classed as mature. Three series of cutting experiments have been established in mature jack pine stands. In addition, several small plots are being employed to study particular problems such as the effect of soil treatment on germination and early growth. Spruce cutting experiments have been started both in upland and swamp types. The cutting experiments as a whole cover about 70 acres. Thinning and pruning plots round out the picture of the management of well-stocked stands of desirable species.

Many areas of low-value aspen could be converted to other species that will command better stumpage price. Conversion experiments, which include release cutting, under planting, and clear cuttings followed by planting, have been designed to study various phases of this problem.

PLANTING, which is closely allied to conservation work, is also being studied. Several experiments are now in progress concerning age and size of stock, spring planting versus fall planting, choice of species, rabbit control, density of overstory, effect of ground cover and methods of planting. An 18-acre Norway and Scotch pine plantation should caution future foresters to select seed from proper sources for planting. The seed from which the stock was developed was collected from more than 200 widely scattered sources. Some evidences of racial difference have already been observed.

The large increase in forestry activities which was caused by the work relief programs of the past few years has stimulaetd the interest in forest research work. The experimental forest has benefited from this situation, and in turn the investigations which are being carried on there have been of use to practicing foresters.